ISOTHERMS AND KINETICS STUDIES OF LEAD ADSORPTION ON JATROPHA SEED HUSK

FAHEEM AHMED QAID MOHAMMED SGC080037

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**SUPERVISOR
DR. SHARIFAH BINTI MOHAMAD**

Abstract

Presence of lead, a heavy metal in the environment has been a serious concern especially with rapid industrialization which has created new uses for lead. The acute toxicity of lead to aquatic Life and humans and the stringent effluent standard to be met by industries as specified by regulatory organizations has necessitated the development of innovative, effective and economical methods for treating lead-bearing wastewater. An adsorption process using an inexpensive adsorbent such as Jatropha seed husk is an attractive option for the removal of lead from wastewater.

In this study batch isotherm and kinetic studies were carried out on a laboratory scale to evaluate the adsorption capacity of Jatropha seed husk and contact time on lead removal was studied. Desorption studies were also conducted using deionized water to evaluate desorption of lead from Jatropha seed husk. Batch kinetic studies indicated that Jatropha seed husk was effective in removing 95.5% of lead. The equilibrium time was determined to be 60 min and pH was found to be 5.5 ± 2. The kinetics of adsorption of lead ions on Jatropha seed husk could be adequately described by the Lagergren model and pseudo-second order reaction rate model. The batch isotherm studies showed that the adsorption data can be described by the Langmuir and Freundlich. Langmuir model was found to describe the adsorption data better compared to the Freundlich.

Abstrak

Kehadiran plumbum, logam berat dalam persekitaran telah menjadi perhatian serius terutamanya dengan industrialisasi yang pesat telah menjadikan penggunaan baru bagi plumbum. Ketoksikan akut menyebabkan hidupan air dan manusia dan standard efluen yang ketat yang harus dipenuhi oleh industri seperti yang ditetapkan oleh undang-undang organisasi telah menyebabkan keperluan pembangunan kaedah inovatif, efektif dan ekonomis untuk merawat air sisa plumbum. Proses jerapan menggunakan sekam biji Jatropha sebagai penyerap merupakan pilihan yang menarik untuk mennyingkirkan plumbum dari air sisa.

Dalam kajian ini batch isoterm dan kajian kinetik dilakukan pada skala makmal untuk menilai keupayaan jerapan kulit biji Jatropha dan masa kenalan pada penyisihan plumbum dikaji. Kajian penyahjerapan juga dilakukan menggunakan air ternyahion untuk menilai nyahjerapan plumbum dari kulit biji Jatropha. Batch kajian kinetik menunjukkan bahawa sekam biji Jatropha sangat efektif dalam mengurangkan 95.5% plumbum dari akues. Masa keseimbangan tercapai pada 60 minit dan pada pH 5.5 ± 2. Kinetik jerapan ion plumbum pada kulit biji Jatropha dapat dijelaskan oleh model Lagergren dan model kadar tindak balas pseudo-dua tingkat. Kajian batch isoterm menunjukkan bahawa data jerapan dapat dijelaskan oleh Langmuir dan Freundlich. Langmuir model dapat menggambarkan data jerapan lebih baik berbanding dengan Freundlich.

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATION

q_e amount of metal ion adsorbed at equilibrium.

q_m maximum adsorption capacity

b amount of adsorbate adsorbed per unit weight of adsorbent (mg/g)

Ce concentration of adsorbate in solution at equilibrium (mg/L).

mg milligram

L liter

g gram

q_{max} the maximum adsorption capacity corresponding to complete monolayer coverage on the surface (mg/g)

R_L separation factor

n adsorption equilibrium constant

K_F Freundlich constants

K_L Lagergren rate constant for adsorption (h^{-1}).

h hour

q_t amount of metal ion adsorbed at any time

K_2 the second order reaction rate constant for adsorption

R^2 correction coefficient

Co initial metal concentrations in the solution

Ce concentration of adsorbate in solution at equilibrium

V throughput volume

W dry weight (g) of the added Modification jatropha seed husk

$\mathbf{a_t}$ amount of Pb^{2+} adsorbed from lead solution by the adsorbent at the various time

%Rem percentage of Lead metal removed from the aqueous solutions by the adsorbent.

rpm revolutions per minute

T absolute temperature

t time

min minute

C_i initial metal concentration (in equation 4.1)

K Kelvin (in figure 4.1)

M_1 high or original concentration

V_1 volume needed of original concentration

M_2 low or new concentration

V_2 total volume of new concentration